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(54) **A speed control apparatus for operating a centrifugal atomiser**

(57) A speed control apparatus for operating a centrifugal atomiser (10) driven by an air turbine (28), comprises: a first pressurised air line (14) coupled to the air turbine for causing it to rotate at a first predetermined speed; a second pressurised line (33) coupled to an air valve (34), whose outlet is coupled to the air turbine for causing it to rotate at a second predetermined speed; a liquid supply line (30) having an actuable liquid dispense valve (19) for controlling flow of liquid therethrough to the atomiser; and a solenoid valve (36) for substantially simultaneously actuating the air valve (34) and the liquid dispense valve (19). Alternatively the valves (19,34) may be actuated simultaneously by manually-actuated valve (38).

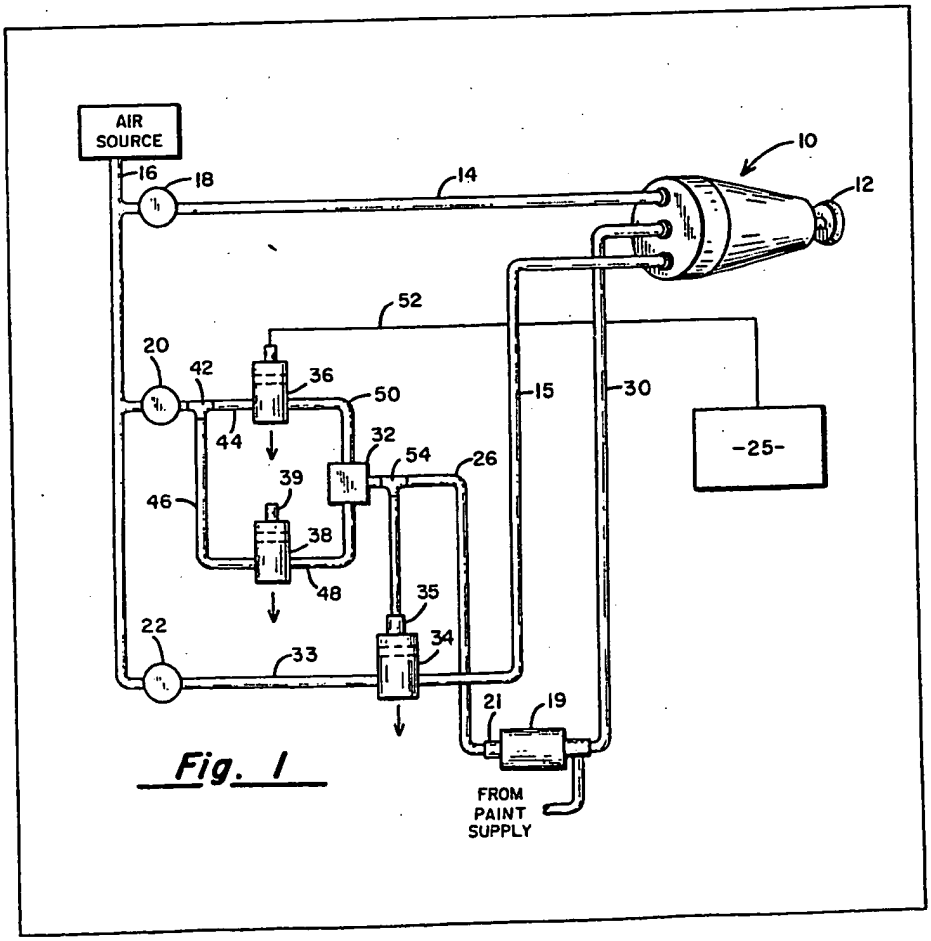

Fig. 1

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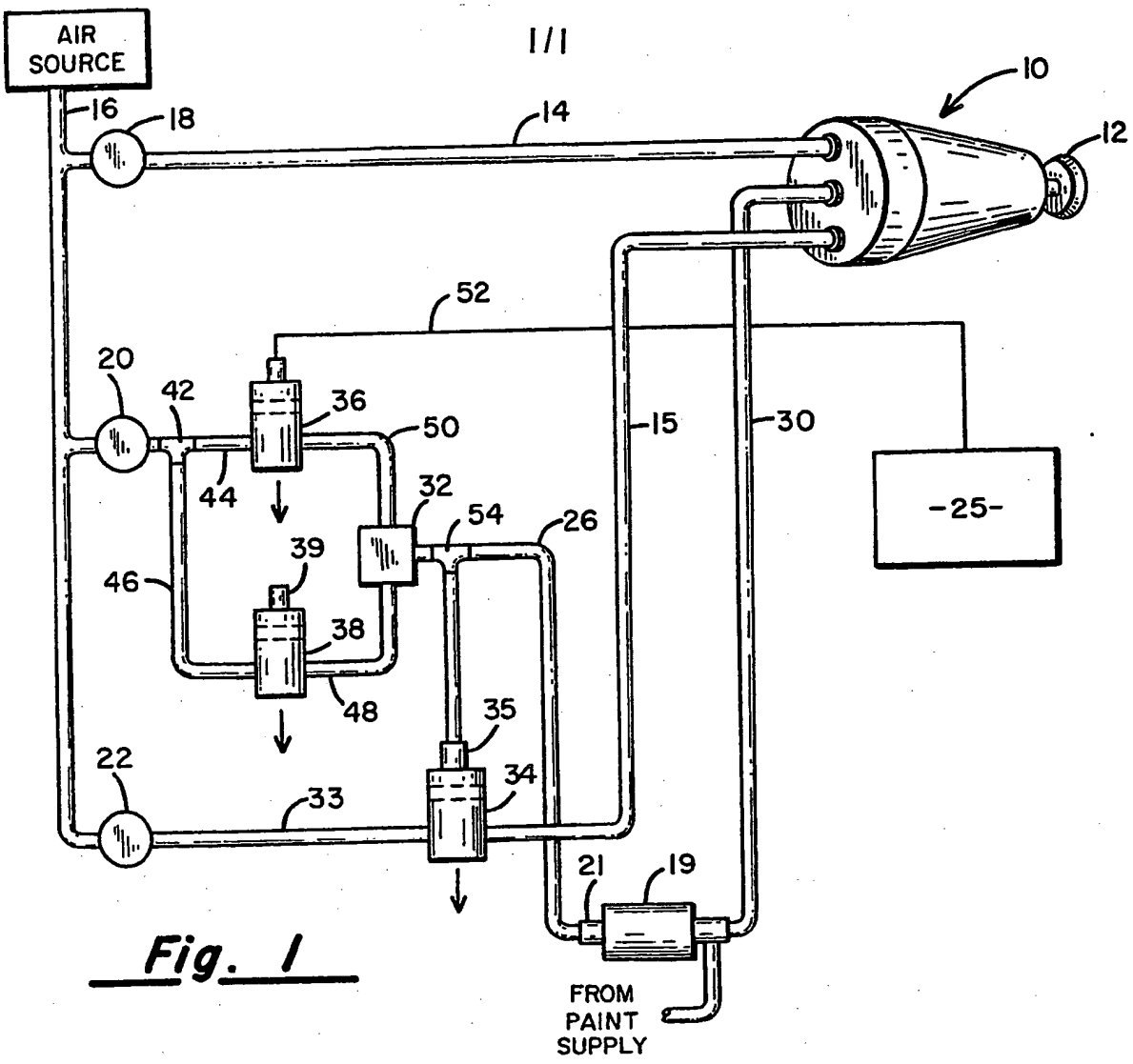
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FROM PAINT SUPPLY

Fig. 1

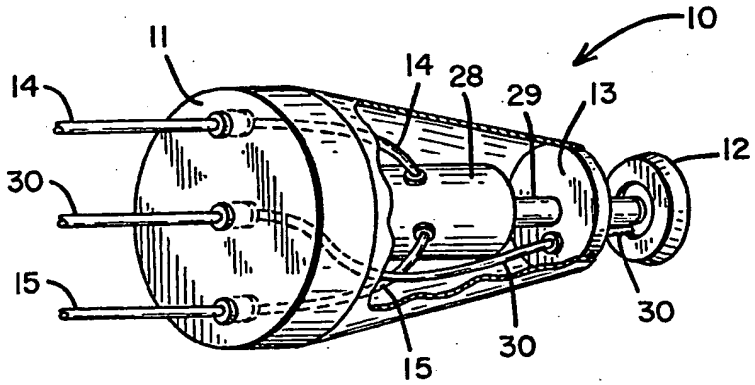
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Fig. 2

SPECIFICATION

A speed control apparatus for operating a centrifugal atomiser

This invention relates to speed control apparatus for operating centrifugal atomisers and in particular, although not so restricted, to centrifugal paint atomisers.

Centrifugal atomisers have long been used in the application of paint to articles. Such atomisers have curved or saucer-shaped discs which are typically driven by air turbine motors at high angular rotations, i.e. 30,000 - 50,000 revolutions per minute (RPM). To achieve such high rates of rotation utilising air turbine motors it is necessary to keep the rotating inertia at a minimum and to utilise precision bearing assemblies so as to minimise friction. The low inertia of such spinning assemblies minimises wear and permits high speed rotation, but is subject to the loading effects of the paint flow therethrough. Typically, paint is applied in a thin column *via* a hose directly to the spinning disc itself, and is centrifugally distributed across the disc and then distributed in finely atomised droplets from the outer circumferential edge of the disc. Thus, when paint is being applied by such a system there is a thin film of liquid paint relatively evenly distributed across the face of the disc. This thin film of paint creates a loading effect on the air turbine motor driving the disc and a consequent reduction in the speed of rotation of the disc. Since the degree of atomisation of the paint is directly related to the speed of rotation of the disc the net result is the atomised paint droplets may be larger than desirable and may provide a thicker or more uneven coating to the article being painted. If the unloaded speed is initially set higher than needed in order to compensate for the slow down during loading there is created a problem in excessive wear of the air turbine motor and its bearings.

Centrifugal atomisers are advantageously used in automatic paint lines, in association with conveyors where articles to be painted are spaced along the conveyor and automatically moved into a paint spray booth enclosing the atomisers. The atomisers are fixedly or movably placed within the spray booth and the paint flow system to the atomisers is selectively timed so as to provide atomising paint in synchronisation with the article as it moves past an atomiser. In applications such as this the atomiser must maintain a relatively high rate of rotation while the conveyor is operating so as to be ready to come into the painting mode, and the movement of the conveyor line, or some control system associated with the conveyor line, causes the paint flow to the atomiser to be controlled.

The present invention is equally applicable to such automatic systems, provision being made for automatically increasing the angular rotation of the atomiser disc at the same time as the signal is developed for turning on paint flow to the atomiser.

According to one aspect of the present invention there is provided a speed control apparatus for operating a centrifugal atomiser driven by an air turbine, comprising: a first pressurised air line arranged to be coupled to said air turbine for causing it to rotate at a first predetermined speed; a second pressurised line coupled to an air valve, whose outlet is arranged to be coupled to said air turbine for causing it to rotate at a second predetermined speed; a liquid supply line having an actuable liquid dispense valve for controlling flow of liquid therethrough to the atomiser; and actuating means for substantially simultaneously actuating said air valve and said liquid dispense valve.

According to another aspect of the present invention there is provided a speed control apparatus for operating a centrifugal atomiser driven by an air turbine, comprising: a source of pressurised air; a first pressure regulator coupled to said source of pressurised air, and a line for coupling said first pressure regulator to said atomiser; a second pressure regulator coupled to said source of pressurised air, and a first air-actuable valve coupled to said second pressure regulator, and a line for coupling said first air-actuable valve to said atomiser; a third pressure regulator coupled to said source of pressurised air, and a solenoid valve coupled to said third pressure regulator; a liquid supply line for coupling to said atomiser, and a second air-actuable valve in said liquid supply line; and air coupling means from said solenoid valve to said first and second air-actuable valves, for substantially simultaneously actuating said first and second air-actuable valves upon electrical energization of said solenoid valve.

The present invention seeks to provide (a) a speed control apparatus to maintain a constant atomising speed on a centrifugal paint atomiser during conditions of no load and full load, and (b) a constant speed centrifugal atomiser whereln additional air pressure is supplied to drive the atomiser only when loading conditions demand such additional pressure.

The invention is illustrated, merely by way of example in the accompanying drawings, in which:-

Figure 1 is a schematic view of a speed control apparatus according to the present invention for a centrifugal atomiser; and

Figure 2 shows a centrifugal atomiser for use with the speed control apparatus of Figure 1.

Referring to the drawings, there is shown an embodiment of a speed control apparatus according to the present invention. A centrifugal atomiser 10 is preferably positioned in a spray booth also having a movable conveyor line therein (not shown). The atomiser 10 is positioned in proximity to the conveyor line so that articles carried by the conveyor pass in front of a disc 12. The disc 12 is connected to a high speed rotating air turbine 28, as shown in Figure 2, for high speed rotation. A pressurised air line 16 is connected to a source of air pressure, typically in the range of 20,000 kg/m^2 to 100,000 kg/m^2 (30 to 150 p.s.i.). The air line 16 is connected to three air pressure regulators 18, 20 and 22. These regulators are of the type commonly used in the industry, as for example Model R10, manufactured by Watts Regulator Company. The regulators 18, 20, 22 may be manually set to provide a regulated air pressure at the respective output lines.

A first air inlet line 14 is coupled between the

regulator 18 and the atomiser 10. The regulator 20 is coupled to a T-connector 42, which is also coupled to air lines 44,46. The line 46 is coupled to a manually operable valve 38, which is a type of valve well-known in the industry, as for example Model MJV-3, manufactured by Clippard Instrument Lab. The valve 38 has a pushbutton actuator 39, which, when manually depressed, permits pressurised air to flow from the inlet line 46 to an outlet line 48. The line 44 is coupled to a solenoid valve 36, which in turn is coupled to an air line 50. The solenoid valve 36 is actuated by an electrical signal on a wire 52, which energizes an electrical coil (not shown) in the solenoid valve 36 to cause magnetic actuation of the valve. Actuation of the valve 36 permits pressurised air to flow from the line 44 to the line 50. The lines 48,50 are connected to a shuttle valve 32, which is a type of valve commonly known in the industry, as for example Model MJSV-1, manufactured by Clippard Instrument Lab. The valve 32 is connected to a T-connector 54, one side of which is coupled *via* a line 26 to an air actuator 21 of a paint dispense valve 19. The paint dispense valve 19 may be a commercially available valve such as Model 205-435, manufactured by the Applicants. The other outlet of the T-connector 54 is connected to an air actuator 35 of a valve 34. The paint dispense valve 19 is coupled to a paint supply (not shown) for causing paint to flow through a paint inlet line 30.

The regulator 22 is connected to the valve 34 *via* a line 33. The application of pressurised air to the actuator 35 causes the valve 34 to become actuated, thereby permitting pressurised air to flow from the line 33 to a second air inlet line 15 and so to the atomiser 10.

The wire 52 is connected to an automatic controller 25, which may take many forms. For example, the controller 25 may be a simple switching mechanism which is coupled to the conveyor line so as to develop a signal on the wire 52 whenever an article to be painted enters the proximity of the disc 12 in the spray booth. Alternatively, the controller 25 may be a programmable digital computer used in conjunction with an automated assembly line, wherein one of the computer's functions is to control the actuation of the atomiser 10. Such a system typically monitors the progress of articles moving along conveyors and actuates various automated tools for performing work operations on the articles. In conjunction with the monitoring and actuation functions performed by such an automatic controller, it could also generate an electrical signal on the wire 52 for purposes of actuating the valve 36. The automatic controller 25 does not form a part of the present invention, its significance merely being that of a device to provide an electrical actuation signal for the valve 36.

Figure 2 shows the atomiser 10 in greater detail and with a portion thereof broken away. The air turbine 28 has an output shaft 29 which rotates therewith, and to which the disc 12 is securely attached. The line 15 passes through a rear housing 11 of the atomiser 10 and is coupled to the air turbine 28 by means of a suitable coupling. This connection admits pressurised air within the line 14 into the interior of the air turbine 28 for purposes of causing rotation of the shaft 29 at a predetermined rotational speed which is a function of the air pressure within the line 14. The line 15 passes through a second opening in the rear housing 11 of the atomiser 10, and is also coupled to the air turbine 28, thereby providing a second pressurised air inlet into the air turbine for causing rotation of the shaft 29. The rotational speed of the shaft 29 is therefore determined by the additive combination of the air pressures in the lines 14, 15 such that it will rotate at a first predetermined speed if one of the air lines is pressurised and at a second more rapid speed if both air lines are pressurised.

The line 30 passes through a third opening in the rear housing 11 of the atomiser 10, and further passes through a front housing 13 of the atomiser 10. The line 30 opens into an annular opening in the disc 12 so as to admit paint onto the forward surface of the disc 12. While paint is admitted at a single point, namely the opening of the line 30, the high rotational speed of the disc 12 causes such paint to become evenly distributed over the forward surface of the disc 12.

In operation, the regulator 18 is first-adjusted to provide a predetermined air pressure in the line 14, so as to cause rotation of the shaft 29 and disc 12 at a first predetermined speed. This is the rotational speed of the atomiser under unloaded conditions, and may be set by means of a tachometer measuring device (not shown) which measures the rotational speed while appropriate adjustment is made to the regulator 18. Next, a signal is applied to the wire 52 to activate the valve 36, and the regulator 20 is adjusted to provide a predetermined "pilot air pressure" to all air-actuated valves *via* the lines 35, 26. The line 26 is coupled to the paint actuator 21 so as to cause actuation of the paint dispense valve 19, which provides a flow of paint through the line 30. The regulator 22 is adjusted to provide a second predetermined pressure in the line 15, which is additively applied to the air turbine 28, and thereby the disc 12, at a predetermined speed which is determined to be desirable under paint flow conditions. For example, the regulator 18 may be set at a low pressure position to cause the disc 12 to rotate at a relatively low speed during periods when paint is not being applied. The regulator 22 may be set to provide a desired paint flow rate and the disc 12 rotational speed combination for application of the desired film coating under optimum atomisation conditions of paint flow. Once the valves have been set according to this predetermined fashion, the system may be operated in continuous or intermittent mode by merely actuating and deactuating the signal on the wire 52. Alternatively, the system may be operated by manual actuation of the valve 38. Typically, a sensing mechanism (not shown) which is related and attached to the conveyor line applies a signal on the wire 52 such that the atomiser delivers paint only when an article on the conveyor line is properly positioned to receive the atomised paint from the disc 12. Alternatively, and in more complex systems, the signal on the wire 52 may be actuated by means of a computer or other processor mechan-

ism which controls not only the operation of the atomiser but also the operation of the conveyor line according to variable conditions.

CLAIMS

1. A speed control apparatus for operating a centrifugal atomiser driven by an air turbine, comprising: a first pressurised air line arranged to be coupled to said air turbine for causing it to rotate at a first predetermined speed; a second pressurised line coupled to an air valve, whose outlet is arranged to be coupled to said air turbine for causing it to rotate at a second predetermined speed; a liquid supply line having an actuable liquid dispense valve for controlling flow of liquid therethrough to the atomiser; and actuating means for substantially simultaneously actuating said air valve and said liquid dispense valve.

2. An apparatus as claimed in claim 1 in which said actuating means comprises a solenoid valve connected to said air valve and said liquid dispense valve.

3. An apparatus as claimed in claim 2 in which said actuating means includes a manually actuable valve connected in parallel across said solenoid valve.

4. An apparatus as claimed in any preceding claim including a first pressure regulator coupled to said first pressurised line, and a second pressure regulator coupled to said second pressurised line.

5. An apparatus as claimed in claim 4 when dependent on claim 2 or 3 including a third pressurised line having the solenoid valve therein, and arranged to permit said third pressurised line to actuate substantially simultaneously said air valves and said liquid dispense valve.

6. An apparatus as claimed in claim 5 including a third pressure regulator coupled to said third pressurised line.

7. An apparatus as claimed in claim 6 including a common pressurised air source coupled to said first, second and third pressure regulators.

8. A speed control apparatus for operating a centrifugal atomiser driven by an air turbine, comprising: a source of pressurised air; a first pressure regulator coupled to said source of pressurised air, and a line for coupling said first pressure regulator to said atomiser; a second pressure regulator coupled to said source of pressurised air, and a first air-actuable valve coupled to said second pressure regulator, and a line for coupling said first air-actuable valve to said atomiser; a third pressure regulator coupled to said source of pressurised air, and a solenoid valve coupled to said third pressure regulator; a liquid supply line for coupling to said atomiser, and a second air-actuable valve in said liquid supply line; and air coupling means from said solenoid valve to said first and second air-actuable valves, for substantially simultaneously actuating said first and second air-actuable valves upon electrical energisation of said solenoid valve.

9. A speed control apparatus for operating a centrifugal atomiser substantially as herein described with reference to and as shown in the accompanying drawings.

10. A speed control apparatus as claimed in any preceding claim in combination with a centrifugal atomiser.

11. A speed control apparatus for operating centrifugal atomisers, of the type driven by an air turbine, comprising a first pressurised air line coupled to said air turbine for providing a rotational drive force at a first predetermined speed; a second pressurised line coupled to an air valve, the outlet of said air valve coupled to said air turbine for providing a rotational drive force at a second predetermined speed; a liquid supply line to said atomiser, said supply line having coupled thereto an actuable liquid dispense valve for controlling the flow of liquid therethrough; and means for substantially simultaneously actuating said air valve and said liquid dispense valve.

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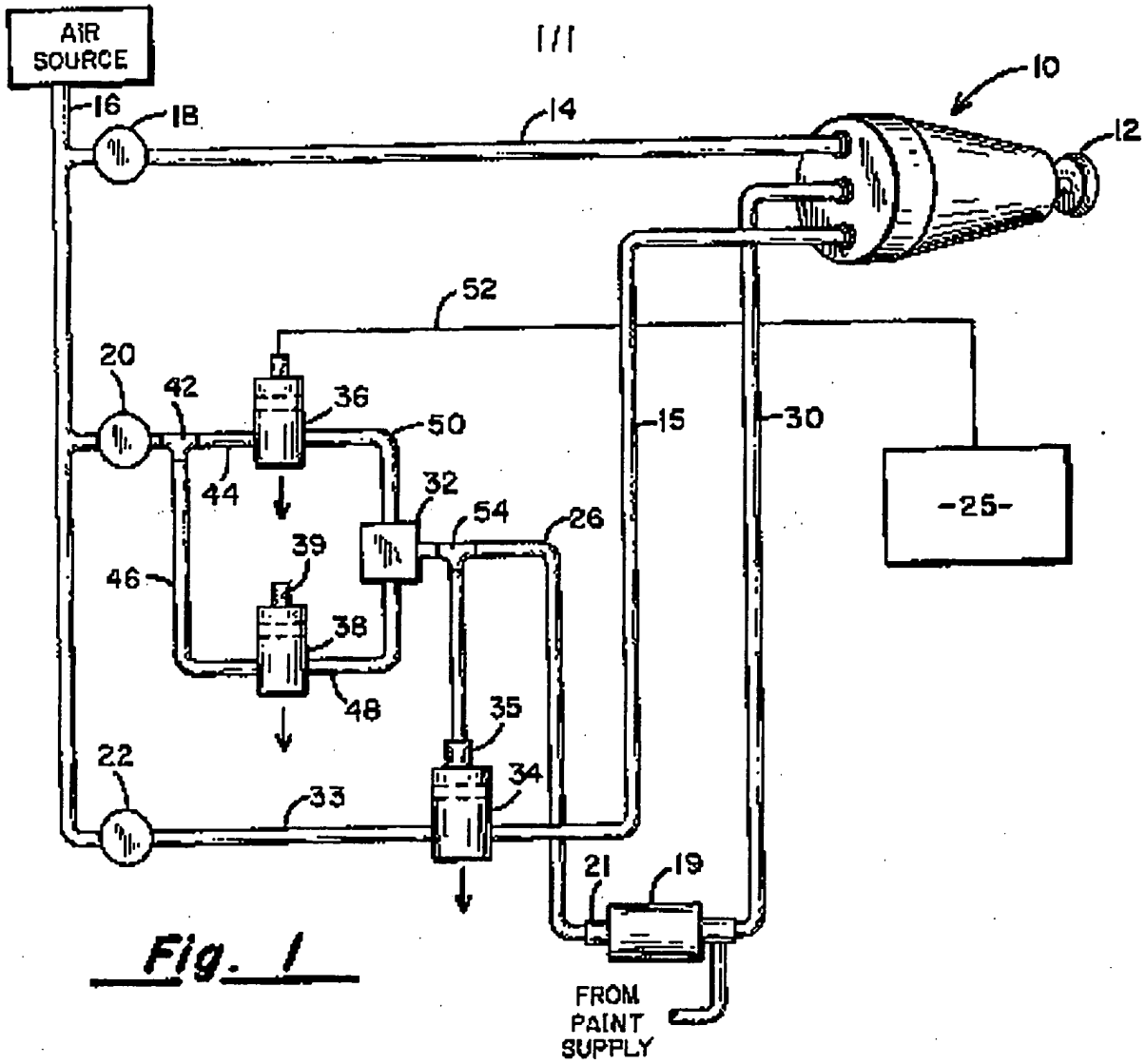
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Fig. 1

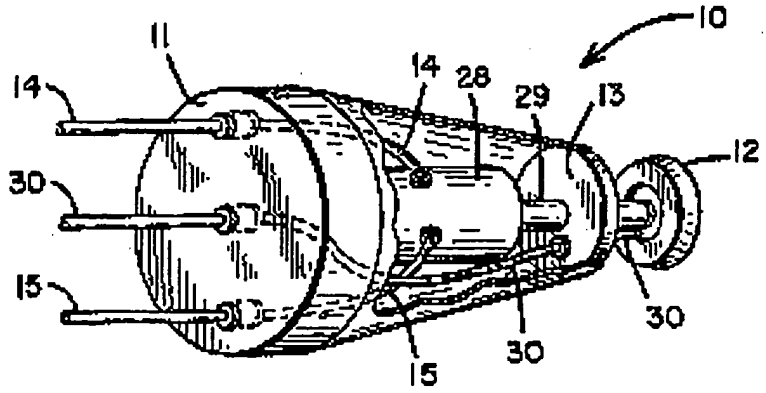
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Fig. 2